Ex parte Kashiwaya

94-1701

THIS OPINION WAS NOT WRITTEN FOR PUBLICATION

The opinion in support of the decision being entered today (1) was not written for publication in a law journal and (2) is not binding precedent of the Board.

Paper No. 16

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Ex parte MAKOTO KASHIWAYA

Appeal No. 94-1701
Application 07/673,382[1]

HEARD: July 9, 1996

Before KIMLIN, GARRIS and OWENS, *Administrative Patent Judges.*

OWENS, *Administrative Patent Judge.*

DECISION ON APPEAL

This is an appeal from the examiner's final rejection of claims 4-6 and 11-36, which are all of the claims remaining in the application. Claims 4, 15, 19 and 31 are illustrative and

[1]Application for patent filed March 22, 1991.

are appended to this decision as they appear in the appendix to appellant's brief.

THE REFERENCES

Hartsough et al. (Hartsough)	4,125,446	Nov. 14, 1978
Kobayashi et al. (Kobayashi)	4,444,635	Apr. 24, 1984
Yamada et al. (Yamada)	4,680,742	Jul. 14, 1987
Ohta et al. (Ohta '137)	4,719,137	Jan. 12, 1988
Akira et al. (Ohta '256)[2] (European patent application)	0192256	Aug. 27, 1986

THE REJECTION

Claims 4-6 and 11-36 stand rejected under 35 U.S.C. § 103 as being unpatentable over Ohta '137 or Ohta '256, in view of Hartsough, Kobayashi and Yamada.

OPINION

We have carefully considered all of the arguments advanced by appellant and the examiner and agree with the examiner that the subject matter of claims 4-6 and 11-14 would have been obvious to one of ordinary skill in the art at the time of appellant's invention over the applied references. Accordingly,

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[2]Since this reference was referred to as "Ohta '256" during prosecution, we likewise do so.

the aforementioned rejection of these claims will be affirmed. However, we agree with appellant that the rejection of claims 15-36 is not well founded. Hence, we will reverse the rejection of these claims.

Appellant's invention is a magneto-optical recording medium and a method of making it. The recording medium includes a transparent substrate, a recording layer overlaid on at least one surface of the transparent substrate, and a 300-1000 Å thick metal reflection layer overlaid on the recording layer. Dielectric layers can be positioned between the substrate and the recording layer and between the recording layer and the reflection layer. Appellant acknowledges that the above structure, except for the thickness of the reflection layer, is prior art (specification, page 2, lines 1-7). Appellant forms the recording, reflection and dielectric layers by sputtering in an inert gas. Appellant acknowledges that formation of these layers by sputtering, *per se*, is prior art. *Id.*

Both appellant's method and article claims are directed toward four embodiments wherein the residual hydrogen or residual hydrogen and residual nitrogen are controlled during formation of a layer by sputtering. Appellant states that control of the residual hydrogen or residual hydrogen and residual nitrogen as claimed during the sputtering causes the recording medium to have stable bias magnetic field characteristics and erasing-writing-reproducing characteristics over a period of many erasing-writing-reproducing cycles (e.g., tens of thousands of cycles) (specification, page 7, line 15 - page 8, line 7; page 8, line 27 - page 9, line 8).

In one embodiment, when the reflection layer is formed, the residual hydrogen and residual nitrogen are controlled such that the residual hydrogen is no more than 10,000 ppm and the residual nitrogen is no more than 1,000 ppm with respect to the amount of inert gas (claims 4-6 and 11-14). In a second embodiment, when the recording layer is formed, the residual hydrogen is controlled at a level of not more than 1,000 ppm (claims 15-18 and 23-26). In a third embodiment, both the residual hydrogen and residual nitrogen are controlled not to exceed 1,000 ppm during formation of the recording layer (claims 19-22 and 27-30).

In a fourth embodiment, when at least one dielectric layer is formed, the residual hydrogen is controlled at no higher than 1,000 ppm (claims 31-36).

Ohta '137 and Ohta '256 disclose magneto-optical recording elements having, on a transparent substrate, a dielectric layer, a recording layer, a second dielectric layer, and an Al-Ni alloy reflection layer, in that order (Ohta '137, col. 4, lines 50-62; Ohta '256, page 8, lines 6-20 and page 9, lines 2-15). Ohta '137 discloses that the magnetooptical recording element normally is formed by sputtering (col. 4, lines 37-38), and Ohta '256 discloses formation of the reflection layer by sputtering (page 8, line 27 - page 9, line 2).

Hartsough discloses depositing aluminum or aluminum alloy films having a predetermined reflectance or resistivity by sputtering an aluminum target containing up to about 10% of other metals while accurately controlling certain deposition parameters including the partial pressure of various reactive gases such as nitrogen, hydrogen, oxygen and water vapor, which are minor constituents of the sputtering gas (col. 1, line 56 - col. 2, line 6). Hartsough teaches that as the partial pressure of hydrogen or nitrogen decreases, the reflectance of the films increases (Fig. 1).

Kobayashi discloses a plasma sputtering method for forming on a substrate a composite film such as a silicon alloy film (col. 1, lines 4-6; col. 2, line 53 - col. 3, line 7). Kobayashi teaches that if the vacuum chamber walls or mechanical elements within the vacuum chamber are heated, gases such as H_2O, O_2, and N_2 are released and become part of the film, and "tend to deteriorate the film property" (col. 3, lines 17-25).

Yamada discloses forming a silicon nitride dielectric layer for a magneto-optical recording medium by incorporating into the silicon nitride an agent for improving the refractive index of the silicon nitride such that the dielectric layer has a refractive index of at least 2.15 (col. 2, lines 55-65). Yamada teaches that such a dielectric layer is resistant to oxygen and humidity (col. 2, lines 42-49). The dielectric layer is formed by sputtering a silicon nitride target in an inert gas such as argon or nitrogen, and Yamada teaches that the degree of vacuum in the sputtering chamber prior to introduction of the inert gas must be controlled so that residual gases in the apparatus such as water, oxygen and nitrogen do not cause formation of silicon oxynitride (col. 7, lines 1-8 and 35-51).

Rejection of claims 4-6 and 11-14

The Ohta references differ from the invention recited in claim 4 in that there is no disclosure of controlling the content of residual hydrogen at not higher than 10,000 ppm and residual nitrogen at not higher than 1,000 ppm with respect to the amount of inert gas. However, Ohta '137 indicates that freedom of the Al-Ni alloy reflection film of impurities ensures a high reflection factor (col. 2, lines 49-51), and Ohta '256 teaches that a deterioration of the performance of the reflective film takes place if the reflectivity of the Al-Ni reflection film drops (page 11, lines 6-8). Since a high reflectance of the reflection film in the Ohta recording elements is a desirable property of the film as indicated by these teachings, one of ordinary skill in the art would have been motivated to make the Ohta reflection film highly reflective. Further, it would have been obvious to such a person to make the film free of impurities in view of the Ohta '137 disclosure so that the high reflectivity would be obtained.

The Ohta references do not disclose the extent to which impurities must be minimized in order for the reflection films to be highly reflective. However, Hartsough teaches that when a highly reflective aluminum or aluminum alloy film is formed by sputtering, control of certain deposition parameters including the level of nitrogen and hydrogen in the sputtering chamber enables a reflective film to be formed which has a reflectance which is as high as that of a film produced by vacuum deposition (col. 1, line 56 - col. 2, line 13). Hartsough teaches that as the partial pressure of hydrogen or nitrogen decreases, the reflectance of the film increases (Fig. 1).

The parts-per-million (ppm) values of residual nitrogen and residual hydrogen recited in appellant's claims are obtained by dividing the partial pressure of nitrogen and hydrogen, respectively, by the inert gas partial pressure (specification, page 47, lines 11-15). Hartsough does not disclose the partial pressure of hydrogen or nitrogen in the sputtering chamber relative to that of the inert gas. However, Hartsough teaches that the maximum partial pressures which produce a reflectance of above 90% are about 10^{-7} torr for nitrogen and about 10^{-6} torr for hydrogen (Fig. 1), and that the preferred total pressures are $5x10^{-4}$ to $5x10^{-2}$ torr (col. 2, lines 3-4). From this disclosure, the maximum partial pressures of hydrogen and nitrogen relative to the partial pressures of the total other gases in the chamber at which a reflectance above 90% can be obtained can be estimated, and are seen to be well within the ranges recited in appellant's claims.

The ratio of the amount of nitrogen relative to the amount of the remainder of the gas, where the partial pressure of the nitrogen is 10^{-7} torr and the total pressure of the gas is $5x10^{-4}$ torr, is about 200 ppm.[3] For a total pressure of $5x10^{-2}$ torr, this relative amount of nitrogen is about 2 ppm.[4] In appellant's

[3] 10^{6} x $10^{-7}/(5x10^{-4} - 10^{-7})$

[4] 10^{6} x $10^{-7}/(5x10^{-2} - 10^{-7})$

claim 4, the amount of residual nitrogen is "not higher than 1,000 ppm". The amount of hydrogen relative to the amount of the remainder of the gas, where the partial pressure of the hydrogen is 10^{-6} torr and the total pressure of the gas is $5x10^{-4}$ torr, is about 2000 ppm.[5] For a total pressure of $5x10^{-2}$ torr, this relative amount of hydrogen is about 20 ppm.[6] In appellant's claim 4, the amount of residual hydrogen is "not higher than 10,000 ppm".

While the above parts-per-million of nitrogen and hydrogen are based on the remainder of the gas other than the nitrogen or hydrogen rather than on only the inert gas, they indicate that the maximum amounts of residual nitrogen and residual hydrogen relative to the inert gas which can be present when forming reflective films by sputtering, which have the high reflectances which the Ohta references teach are desirable, are low amounts such as those recited in appellant's claims. The specific

[5] 10^{6} x $10^{-6}/(5x10^{-4} - 10^{-6})$

[6] 10^{6} x $10^{-6}/(5x10^{-2} - 10^{-6})$

maximum amounts of residual nitrogen and residual hydrogen which may be present when forming a reflection film having the desired reflectivity would have been determinable by one of ordinary skill in the art through no more than routine experimentation in view of the Ohta and Hartsough teachings. *In re Boesch*, 617 F.2d 272, 276, 205 USPQ 215, 219 (CCPA 1980); *In re Aller*, 220 F.2d 454, 457, 105 USPQ 233, 236 (CCPA 1955).

For the above reasons, we conclude that the invention recited in appellant's claim 4 would have been *prima facie* obvious to one of ordinary skill in the art at the time of appellant's invention over the applied references. Since appellant states that claims 4-6 and 11-14 stand or fall together (brief, page 5), we also conclude that claims 5, 6 and 11-14 would have been *prima facie* obvious to one of ordinary skill in the art.

Appellant argues that none of the applied references even remotely mentions controlling the residual nitrogen and/or residual hydrogen during formation of specific layers of a magneto-optical recording medium (brief, page 8). The deficiency in this argument is that appellant is attacking the references individually when the rejection is based on a combination of references. *In re Keller*, 642 F.2d 413, 426, 208 USPQ 871, 882 (CCPA 1981); *In re Young*, 403 F.2d 754, 757-8, 159 USPQ 725, 728 (CCPA 1968). The teachings of the Ohta references in combination with Hartsough would have fairly suggested to one of ordinary skill in the art the invention recited in appellant's claim 4 for the reasons given above.

Appellant argues that since Hartsough pertains to semiconductors, one of ordinary skill in the art who desired to improve the stability of bias magnetic field and erasing-writing-recording characteristics would not have looked to it for guidance (brief, page 11). There would have been no motivation, appellant argues, for combining the references. *Id.* We do not consider these arguments to be convincing because, first, Hartsough broadly discloses a method for forming a reflective aluminum or aluminum alloy film by sputtering and does not limit the teaching to the formation of semiconductor films. Second, since the Ohta references do not disclose how the desired highly reflective aluminum alloy sputtered layers are formed, one of ordinary skill in the art would have looked to another reference, such as Hartsough, which discloses how to form such reflective layers.

Appellant argues that the applied prior art fails to acknowledge the problem solved by appellant, and that it is incumbent on the examiner to look to the problem as well as the solution to determine what would have been obvious to one of ordinary skill in the art (brief, page 13). We do not find this argument to be convincing because to establish a *prima facie* case of obviousness, it is not necessary that references be combined for the purpose of solving the problem solved by appellant. *In re Beattie*, 974 F.2d 1309, 1312, 24 USPQ2d 1040, 1042 (Fed. Cir. 1992); *In re Dillon*, 919 F.2d 688, 693, 16 USPQ2d 1897, 1901 (Fed. Cir. 1990) (*en banc*), *cert. denied*, 500 U.S. 904 (1991); *In re Lintner*, 458 F.2d 1013, 1016, 173 USPQ 560, 562 (CCPA 1972).

In the present case, there would have been ample motivation for one of ordinary skill in the art to combine the Ohta references and Hartsough for the reasons discussed above, and to thereby arrive at the invention recited in appellant's claim 4.

Appellant argues that the comparative evidence in appellant's specification demonstrates that control of the residual nitrogen and/or residual nitrogen during layer formation as recited in appellant's claims produces an unexpectedly superior product (brief, page 9). In appellant's specification, Example 1 and Comparative Example 1 are the examples which are directed toward the embodiment in which the residual hydrogen and residual nitrogen are controlled during formation of the reflection layer. We do not consider this comparison to overcome the *prima facie* case of obviousness of claim 4 because the results would have been expected by one of ordinary skill in the art in view of the teachings by Hartsough and Ohta '256.

Hartsough teaches that as the hydrogen or nitrogen content during formation of a sputtered aluminum alloy reflective film increases, the reflectivity of the film decreases (Fig. 1), and

Ohta '256 teaches that as the reflectivity of the Al-Ni reflective film decreases, the C/N ratio deteriorates (page 11, lines 6-11). Thus, the decrease in the C/N ratio relative to the initial C/N ratio as the residual hydrogen or residual nitrogen content is increased during formation of the reflection layer by sputtering, as shown in appellant's Tables 1 and 2, would have been expected by one of ordinary skill in the art. Further, as the C/N ratio deteriorates, one of ordinary skill in the art would have expected the required intensity of the bias magnetic field during erasing and writing to change.

We therefore do not consider appellant's experimental results to be effective for rebutting the *prima facie* case of obviousness of claims 4-6 and 11-14 over the applied references. Accordingly, the rejection of these claims under 35 U.S.C. § 103 over the applied references is affirmed.

Rejection of claims 15-30

Claims 15-30 are directed toward control of residual hydrogen or both residual hydrogen and residual nitrogen during formation of the recording layer, and claims 31-36 are directed toward control of residual hydrogen during dielectric layer formation. The examiner's position is that the secondary references teach or suggest that residual gases in a sputtering chamber cause a deterioration of film properties and that each suggests that it would have been obvious to one of ordinary skill in the art to minimize the amount of residual gases during the formation of each of the Ohta layers (answer, pages 4-5). We do not consider the examiner's position to be well taken with respect to claims 15-36 for the following reasons.

Hartsough pertains to control of residual gases including hydrogen and nitrogen when forming aluminum or aluminum alloy layers which have high reflectance. There is no evidence of record that the technique disclosed therein for forming these high-reflectance layers would have been beneficial when forming recording or dielectric layers which are not intended to be reflective. This reference, therefore, would not have provided one of ordinary skill in the art with motivation to control the level of hydrogen or nitrogen during the formation of recording and dielectric layers.

Yamada relates to the formation of an Si_3N_4 dielectric layer. The reference discloses forming the dielectric layer in an atmosphere of an inert gas such as argon or nitrogen (col. 7, lines 1-7). Yamada teaches that residual gases such as water, oxygen and nitrogen must be kept below a critical value so that silicon oxynitride is not formed (col. 7, lines 44-51). The inclusion of nitrogen among the listed residual gases appears to be an error since Yamada teaches that the sputtering can take place in a nitrogen atmosphere (col. 5, lines 6-7). Yamada does not state that hydrogen must be controlled, and since hydrogen would not contribute to the formation of silicon oxynitride, there appears to be no reason to exclude residual hydrogen in Yamada's method. Thus, Yamada would not have provided one of ordinary skill in the art with motivation to exclude either residual nitrogen or residual hydrogen during formation of the dielectric layer.

Kobayashi discloses forming composite films of a refractory metal and silicon or of an organic material and a metal (col. 2, line 53 - col. 3, line 7; col. 12, lines 22-43). Kobayashi teaches that residual gases such as H_2O, O_2 and N_2, which are released when sputtering chamber walls and mechanical elements within the chamber are heated, "tend to deteriorate the film property" (col. 1, lines 4-6; col. 13, lines 21-25). There is no evidence of record that hydrogen or nitrogen has this effect on recording and dielectric layers. The only secondary reference applied by the examiner which pertains to either of these types of layers is Yamada which, as discussed above, is directed toward removing oxygen-containing gases from the sputtering chamber to avoid forming silicon oxynitride. Consequently, one of ordinary skill in the art, when considering the teaching of Kobayashi alone or in combination with the other applied references, would not have been motivated to control the levels of residual hydrogen or nitrogen when forming recording or dielectric layers.

For the above reasons, the rejection of claims 15-36 is reversed.

DECISION

The rejection of claims 4-6 and 11-36 under 35 U.S.C. § 103 as being unpatentable over Ohta '137 or Ohta '256, in view of

Hartsough, Kobayashi and Yamada is affirmed as to claims 4-6 and 11-14 and reversed as to claims 15-36.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 CFR § 1.136(a).

AFFIRMED-IN-PART

EDWARD C. KIMLIN Administrative Patent Judge	
BRADLEY R. GARRIS Administrative Patent Judge	BOARD OF PATENT APPEALS AND INTERFERENCES
TERRY J. OWENS Administrative Patent Judge	

Appeal No. 94-1701
Application 07/673,382

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APPENDIX

4. A magneto-optical recording medium at least comprising a transparent substrate, a recording layer which is overlaid at least on one surface of the transparent substrate, and a reflection metal layer 300-1000 Å thick which is overlaid on the recording layer,

wherein said reflection metal layer primarily contains Al or an alloy of Al and is formed by carrying out a sputtering process in an atmosphere, in which the content of residual hydrogen gas is not higher than 10,000 ppm with respect to the amount of an inert gas, and the content of residual nitrogen gas is not higher than 1,000 ppm with respect to the amount of the inert gas.

15. A magneto-optical recording medium at least comprising a transparent substrate and a recording layer which is overlaid at least on one surface of the transparent substrate,

wherein said recording layer is formed by carrying out a sputtering process in an inert gas atmosphere, in which the content of residual hydrogen gas is not higher than 1,000 ppm with respect to the amount of an inert gas.

19. A magneto-optical recording medium at least comprising a transparent substrate and a recording layer which is overlaid at least on one surface of the transparent substrate,

wherein said recording layer is formed by carrying out a sputtering process in an inert gas atmosphere, in which the content of residual hydrogen gas is not higher than 1,000 ppm with respect to the amount of an inert gas, and the content of residual nitrogen gas is not higher than 1,000 ppm with respect to the amount of the inert gas.

31. A magneto-optical recording medium comprising a transparent substrate and a magneto-optical recording film overlaid on the transparent substrate, the magneto-optical recording film being composed of at least a first protective dielectric layer, a recording layer, and a second protective dielectric layer, which are overlaid in this order on the transparent substrate,

wherein at least either one of said first protective dielectric layer and said second protective dielectric layer is formed by carrying out a sputtering process in an inert gas atmosphere, in which the content of residual hydrogen gas is not higher than 1,000 ppm with respect to the amount of an inert gas.